MT HOSA Biotechnology

Event Category: Health Professions

Dress Code: Attire appropriate to the occupational area or business casual	**Round One:** 50 Q test (60 minutes) You may use a basic handheld calculator for the test.	**Digital Upload:** Yes, mystery skills video during Jan 18- Feb 12 window
Solo Event: 1 competitor	**Round Two:** Skill(s) assessment	

Event Summary

Biotechnology allows members to gain the knowledge and skills required for a laboratory setting using biotechnology. This competitive event consists of two rounds. Round One is a written, multiple-choice test, and the top-scoring competitors will advance to Round Two for the skills assessment. This event aims to inspire members to learn more about biotechnology careers. Bio-Rad has developed a special landing page for HOSA competitors and advisors.

General Event Information

Competitors Must Provide	• Ruler (metric, with mm marks) • Glasses, safety glasses, face shield or goggles • Closed-toe-shoes • Disposable, non-latex gloves (2 pairs) • Lab coat (optional) HOSA Conference Staff will provide equipment and supplies listed in Appendix I.
Official References	The references below are used in the development of the test questions and skill rating sheets. Bio-Rad has provided additional resources to support competitors in event preparation below. • Brown, J. Kirk. *Biotechnology A Laboratory Skills Course.* Bio-Rad. Latest edition. • Starr and Taggart. *Biology: The Unity and Diversity of Life AP.* National Geographic Learning, Cengage. Latest edition. • Biotechnology Careers • Bio-Rad Resources

ROUND ONE- Test

Test Instructions	All competitors will be given a test and answer sheet. The written test will consist of 50 multiple-choice items in a maximum of 60 minutes. See test instructions here. At the International Leadership Conference, HOSA will provide basic handheld calculators (no graphing calculators) for addition, subtraction, division, multiplication, and square root.

Written Test Plan	The written test for Biotechnology is:
	• Biotechnology industry practices and careers - 4%
	• Biotechnology in health - 4%
	• Governmental regulation of biotechnology - 4%
	• Basic laboratory skills - 14%
	  o PPE
	  o Preparing solutions (calculations, use of balance and other equipment)
	  o Pipetting
	• Microbiology and cell culture - 12%
	• DNA structure and analysis - 14%

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

	• Bacterial transformation - 10% • Polymerase chain reaction (PCR) - 14% • Protein structure, function, and analysis - 14% • Immunological applications - 10%
Sample Test Questions	1. What type of bond connects nitrogenous base pairs and holds the two strands of a DNA molecule together? (Bio-Rad pg 114) **A. Hydrogen** B. Nitrogenous C. Oxygen D. Carbon 2. Which discipline of systems biology investigates the full complement of DNA in a cell? (Bio-Rad pg 5) A. Microbiomics B. Proteomics **C. Genomics** D. Metabolomics 3. What was the first bacterium used commercially to produce genetically engineered human insulin? (Starr pg 240) A. Saccharomyces **B. E. coli** C. Epstein-Barr D. Staphylococci
Mystery Skill Video	This event has a mystery skill video that must be uploaded. The mystery skill will be released along with instructions to upload on January 18th. Videos must be uploaded by **February 12th** at midnight MST as the final deadline, and there will be **NO EXCEPTIONS.** We STRONGLY suggest not waiting until the last minute to upload online to avoid user challenges with the system. Videos must be uploaded to the hosa website for judges to access them. Detailed instructions for uploading materials can be found at https://hosa.org/competitive-event-digital-uploads/ For SLC, the digital materials uploaded by **February 12** will be PRE-SCREENED to qualify for Round 2. Competitors who do not upload materials are NOT eligible for the Round Two presentation portion of the competition and **will NOT be given a competition appointment time at SLC**.

ROUND TWO- Skill Assessment

1. The top competitors from Round One will advance to Round Two. The number of advancing competitors will be determined by the scores obtained in Round One, the mystery skill video upload, and the space and time available for Round Two. Competitors shall report to the event site 10 minutes before their appointment time.

2. Round Two is a selected skill(s) assessment. The skills approved for this event are:

Skills	Textbook (Bio-Rad)	Time Allocated	Video Resource(s)
Skill I: Using Micropipets, Transfer Pipets, and a Balance	pp. 50-53 (Part 3), 381, and 383 (use of balance)	15 min	Videos 1 and 2
Skill II: Restriction Digestion Reaction	p. 140 (Part 1)	15 min	none
Skill III: DNA Gel Electrophoresis	pp. 140-141 (Part 2) 391	20 min	Video
Skill IV: DNA Gel Interpretation	pp. 136-138, 142, 392	15 min	none
Skill V: Bradford Protein Quantitation Assay	pp. 254-255 (through step 10), 395	20 min	Video
Skill VI: Bacterial Transformation	pp. 167-171, 392	20 min	Video
Skill VII: Calculation of Transformation Efficiency	pp. 155-156, 393	10 min	none
Skill VIII: Qualitative ELISA	pp. 314-316, 400	20 min	Video

3. For all skills, body fluids will be simulated products.

4. The selected skill(s) will be presented to competitors as a written scenario at the beginning of the round. The scenario will be the same for each competitor. Where appropriate, scenarios will also provide protocols to those they could expect to see if working in an industry laboratory (these protocols will not be as detailed as those provided in the textbook; students are expected to know basic skills such as micropipet use, labeling of tubes, avoiding sample cross-contamination, lab hygiene, and basic workflows). Some scenarios may involve the combination of multiple skills. In the event rating sheets are combined it is not necessary to repeat a task a second time. An example would be competitors would not need to identify the patient twice. A specific Biotechnology sample scenario can be found HERE.

5. Timing will begin when the scenario is presented to the competitors and will be stopped at the end of the time allowed. The scenario is a secret topic. Competitors MAY NOT discuss or reveal the secret topic until after the event concluded or will face penalties per the GRRs.

6. Competitors must complete all skill steps listed in the guidelines, even if the steps must be simulated/verbalized. (If the equipment is available, the competitors would complete all skill steps as the scenario warrants. The competitors will simulate/verbalize the steps if the equipment is unavailable.)

7. Judges will provide information to competitors as directed by the rating sheets. Competitors may ask questions of the judges while performing skills, if the questions relate to patient's condition and will be included in the scenario or judge script.

8. Competitors must use all equipment correctly and safely. Judges will stop a student and not award points for a step if they see a competitor is about to cause a risk of harm or about to damage equipment or other supplies.

9. Selection of the correct micropipet for a specified volume is an essential skill. Though other micropipets exist (2, 10, or 100 µl, for example), the skills in this competitive event are to be performed using a 20, 20- 200, or 100-1,000 µl micropipet (a p20, p200, or p1000).

10. The protocols for these skills follow protocols given in the Bio-Rad textbook, Biotechnology A Laboratory Skills Course (Brown JK). Note that, in skill VIII, the incubation times have been shortened to enable competitors to complete the skill and see color development within the allotted time.

Final Scoring

1. The competitor must earn a score of 70% or higher on the combined skill(s) in Round Two-Skill Assessment in order to be recognized as an award winner at the ILC.

2. The final rank is determined by adding the round one test score plus the round two skill score. In the event of a tie, the highest test score will be used to determine the final placement.

Future Opportunities

The HOSA Scholarship program has funding available for HOSA members who have an interest in various health careers! The application process begins January 1, 2027, and can be found here: https://hosa.org/scholarships/.

Graduating from high school or completing your postsecondary/collegiate program does not mean your HOSA journey has to end. As a HOSA member, you are eligible to become a HOSA Lifetime Alumni Member- a free and valuable opportunity to remain connected, give back, and help to shape the future of the organization. Learn more and sign up at hosa.org/alumni.

Biotechnology

Skill I: Using Micropipets, Transfer Pipets, and a Balance

Time: 15 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

*For all Judge verification steps, full points are only awarded if all components are accurate.

	Skill I: Using Micropipets, Transfer Pipets, and a Balance	**Possible**	**Awarded**
1.	Entered the testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Labeled 3 microcentrifuge tubes: for example, p200, p1000, and TP.	**4 0**	
3.	Weighed each tube and recorded its mass on the paper provided. ***Judge verified competitor cleared the balance before weighing each tube.***	**4 0**	
Using the 20-200 µl micropipet			
4.	Pipetted 200 µl of the liquid provided into the tube labeled for p200 use. ***Judge verified competitor (i) selected 20-200 µl micropipet, (ii) set it to 200 µl, (iii) used an appropriate pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
5.	Repeated Step 4.	**2 0**	
6.	Pipetted 100 µl of the liquid provided to the tube. Closed the tube tightly. ***Judge verified competitor (i) set the 20-200 µl micropipet to 100 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
Using the 100-1,000 µl micropipet			
7.	Pipetted 500 µl of the liquid provided to the tube labeled for p1000 use. Closed the tube tightly. ***Judge verified competitor (i) selected 100-1,000 µl micropipet, (ii) set it to 500 µl, (iii) used a proper pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
Using the transfer pipet			
8.	Transferred 500 µl of the liquid provided to the tube labeled for transfer pipet use. Closed the tube tightly. ***Judge verified competitor filled the transfer pipet to the appropriate line without air bubbles and transferred the entire volume to the tube.***	**4 0**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Skill I: Continued...		Possible	Awarded
Calculating mass of liquid			
9.	Weighed all three microcentrifuge tubes and recorded mass of each on the paper provided. ***Judge verified competitor cleared the balance before weighing each tube.***	**2 0**	
10.	Calculated the mass of the liquid in each tube (in g) and recorded it on the paper provided. ***Judge verified calculated mass and that the mass of liquid in each tube was ~0.50g (the mass of the liquid transferred using the transfer pipet may differ). Judge confirmed correct units (g) and number of significant figures were used (for example, 0.50 g).***	**2 0**	
Cleaning up			
11.	Cleaned work area: a. Disposed of used pipet tips, microcentrifuge tubes, and transfer pipet in waste receptacle.	**2 0**	
	b. Cleaned work area with surface disinfectant.	**2 0**	
	c. Removed PPE.	**2 0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene. ***Judge verified steps 11 a-d were performed in the order written here.***	**2 0**	
	Total Points- Skill I: 70% Mastery for Skill I: 28	**40**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill II: Restriction Digestion Reaction

Time: 15 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

*For all Judge verification steps, full points are only awarded if all components are accurate.

	Skill II: Restriction Digestion Reaction	Possible	Awarded
1.	Entered the testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Labeled 6 microcentrifuge tubes to match the labels on the DNA samples provided.	**2 0**	
	Judge verified competitor labeled all 6 tubes correctly.		
3.	Pipetted 10 µl of each DNA sample into the corresponding labeled microcentrifuge tube.	**4 0**	
	Judge verified competitor (i) used a 20 µl micropipet, (ii) set it to 10 µl, (iii) used an appropriate and clean pipet tip for \ the sample, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.		
4.	Pipetted 10 µl of enzyme mix (ENZ) into each tube, then mixed by pipetting up and down 2-3 times.	**4 0**	
	Judge verified competitor (i) used a 20 µl micropipet set to 10 µl, (ii) used a clean and appropriate pipet tip between each sample, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.		
5.	Capped each tube tightly and mixed by flicking each tube with fingers.	**2 0**	
6.	Pulse-spinned tubes in a microcentrifuge -or- tapped tubes on table to collect all liquid at the bottom of the tube.	**4 0**	
	Judge verified competitor balanced the tubes in the microcentrifuge or tapped them on the table to collect liquid.		
7.	Verbalized one of the two options for incubation: (i) "*incubating reactions at room temperature overnight*" -or – (ii) "*incubating reactions at 37°C for 45 min*".	**4 0**	
8.	Cleaned work area: a. Disposed of used pipet tips, microcentrifuge tubes, and transfer pipet in waste receptacle.	**2 0**	
	b. Cleaned work area with surface disinfectant.	**2 0**	
	c. Removed PPE.	**2 0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene.	**2 0**	
	Judge verified steps 8 a-d were performed in the order written here.		
	Total Points- Skill II: 70% Mastery for Skill II: 20.3	**30**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill III: DNA Gel Electrophoresis

Time: 20 minutes

Competitor #:_____ **Division:**_____SS, _____PS **Judge's Signature:**_____

*For all Judge verification steps, full points are only awarded if all components are accurate.

	Skill III: DNA Gel Electrophoresis	**Possible**	**Awarded**
1.	Entered the testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
Preparing samples			
2.	Collected the liquid to the bottom of the 6 samples and DNA size standard by either (i) placing tubes into microcentrifuge or mini centrifuge and pulse-spinning for 5–10 seconds, or (ii) by tapping the tubes gently on the table. ***Judge verified competitor balanced the tubes in the microcentrifuge or tapped them on the table to collect liquid.***	**4 0**	
3.	Pipetted 5 µl of sample loading buffer (SLB) into each of the sample tubes. Pipetted up and down or flicking the tubes to mix. ***Judge verified competitor (i) used 20 µl micropipet w proper pipet tip, (ii) set micropipet to deliver 5 µl to all 7 tubes, (iii) used a fresh pipet tip for each sample, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
Loading the gel			
4.	Placed the precast agarose gel into the electrophoresis chamber. ***Judge verified competitor placed* the wells of the agarose gel near the black (-) electrode (cathode).**	**4 0**	
5.	Filled the electrophoresis chamber with 1x TAE buffer; added enough buffer to cover the gel and fill the wells.	**2 0**	
6.	Loaded 10 µl standard (Std) into a well in the gel. ***Judge verified competitor (i) selected 20 µl micropipet and set it to deliver 10 µl, (ii) used a fresh pipet tip of the correct type, and (iii) loaded standard into the gel with no gel breakage or sample overflow into nearby wells.***	**4 0**	
7.	Loaded 20 µl of each sample into separate wells of the gel. ***Judge verified competitor (i) selected 20 µl or 200 µl micropipet and set it to deliver 20 µl, (ii) used a fresh pipet tip of the correct type for each sample, and (iii) loaded samples into the gel with no gel breakage, piercing the bottom of wells, or sample overflow into nearby wells.***	**4 0**	
8.	Recorded the order of sample loading on the sheet provided.	**2 0**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Skill III: Continued...		Possible	Awarded
9.	Placed the lid on the electrophoresis chamber and connected the electrical leads to the power supply. ***Judge verified competitor connected red to red and black to black.***	**1 0**	
10.	Turned on the power and ran the gel at 100 V. **(This step may be verbalized)**	**2 0**	
11.	Verbalized "*run for 30 minutes*".	**2 0**	
12.	Verbalized "*run has completed*", then turned off power and removed lid from chamber.	**1 0**	
Cleaning up			
13.	Cleaned work area: a. Disposed of used pipet tips, microcentrifuge tubes, and transfer pipet in waste receptacle.	**2 0**	
	b. Cleaned work area with surface disinfectant.	**2 0**	
	c. Removed PPE.	**2 0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene. ***Judge verified steps 13 a-d were performed in the order written here.***	**2 0**	
	Total Points- Skill III: 70% Mastery for Skill III: 28	**40**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill IV: DNA Gel Interpretation

Time: 15 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

	Skill IV: DNA Gel Interpretation	**Possible**	**Awarded**
1	Using a ruler, measured the distance (in mm) that each of the DNA fragments or bands traveled from the well. Recorded results for each sample and standard in the table provided.	**4 0**	
2.	Using the semilog graph paper provided, plotted the distance versus size for the bands in the standard.	**6 0**	
3.	Drew a line of best fit through the points.	**4 0**	
4.	Used the graph to estimate the fragment size for each band in the samples. Recorded estimates in the table provided.	**6 0**	
	Total Points- Skill IV: 70% Mastery for Skill IV: 14	**20**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill V: Bradford Protein Quantitation Assay

Time: 20 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

	Skill V: Bradford Protein Quantitation Assay	**Possible**	**Awarded**
1.	Entered the testing area wearing closed-toed shoes, then donned proper PPE glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
Preparing Samples			
2.	Labeled two empty microcentrifuge tubes for the sample dilutions (for example, **1/50 A** and **1/50 B**, or **A** and **B**)	**1 0**	
3.	Pipetted 2 µl of sample A into the microcentrifuge tube labeled 1/50 A. ***Judge verified competitor (i) selected 20 µl micropipet, (ii) set micropipet to correct volume, (iii) used a clean pipet tip, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**2 0**	
4.	Pipetted 98 µl of 1x PBS into the microcentrifuge tube labeled 1/50 sample A. ***Judge verified competitor (i) selected (20-200 µl micropipet, (ii) set micropipet to correct volume, (iii) used a clean pipet tip, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**2 0**	
5.	Mixed well by pipetting, flicking, or vortexing.	**2 0**	
6.	Pipetted 2 µl of sample B into the microcentrifuge tube labeled 1/50 B. ***Judge verified competitor (i) selected 20 µl micropipet, (ii) set micropipet to correct volume, (iii) used a clean pipet tip, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**2 0**	
7.	Pipetted 98 µl of 1x PBS into the microcentrifuge tube labeled 1/50 sample B. ***Judge verified competitor (i) selected 20-200 µl micropipet, (ii) set micropipet to correct volume, (iii) used a clean pipet tip, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**2 0**	
8.	Mixed well by pipetting, flicking, or vortexing.	**2 0**	
9.	Labeled two cuvettes: Sample A and Sample B (or just A and B).	**1 0**	
10.	Pipetted 20 µl of the 1/50 diluted samples into the corresponding cuvettes. ***Judge verified competitor (i) selected 20 µl micropipet, (ii) set micropipet to correct volume, (iii) used a clean pipet tip for each liquid, (iv) used a proper pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Skill V: Continued...		Possible	Awarded
Preparing Standards			
11.	Labeled eight cuvettes for the protein standards: Blank, 0.125, 0.250, 0.500, 0.750, 1.000, 1.500, 2.000	**1 0**	
12.	Pipetted 20 µl of 1x PBS into the cuvette labeled Blank. ***Judge verified competitor (i) selected correct micropipet (20 µl), (ii) set micropipet to correct volume, (iii) used a clean pipet tip, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
13.	Pipetted 20 µl of each protein standard into a corresponding cuvette. ***Judge verified competitor (i) selected correct micropipet (20 µl), (ii) set micropipet to correct volume, (iii) used a clean pipet tip for each standard, (iv) used a proper pipet tip, and (v) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
Adding Bradford Reagent			
14.	Added 1 ml of the 1x Bradford reagent to all ten cuvettes. Mixed well pipetting up and down. ***Judge verified competitor (i) used the correct micropipet (100-1,000 µl), (ii) set micropipet to correct volume, (iii) used a fresh pipet tip for each sample, (iv) used a proper pipet tip, (v) transferred liquid without air bubbles or losing sample in the transfer process, and (vi) pipetted up and down gently to mix (no liquid sucked into the barrel of the micropipet, for example).***	**4 0**	
15.	Verbalized "*cuvettes incubate at room temperature for 5 minutes*".	**1 0**	
16.	After visually comparing the cuvettes containing samples to the cuvettes containing the protein standard, verbalized an estimated protein concentration of the samples.	**4 0**	
Cleaning Up			
17.	Cleaned work area: a. Disposed of used pipet tips, microcentrifuge tubes containing the 1/50 dilutions, and cuvettes in waste receptacles.	**2 0**	
	b. Cleaned work area with surface disinfectant.	**2 0**	
	c. Removed PPE.	**2 0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene. ***Judge verified steps 17a-d were performed in the order written here.***	**2 0**	
	Total Points- Skill V: 70% Mastery for Skill V: **32.2**	**46**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill VI: Bacterial Transformation

Time: 20 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

	Skill VI: Bacterial Transformation	Possible	Awarded
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
Preparing for heat shock			
2.	Labeled one microcentrifuge tube +pGLO and another -pGLO (or just + and -).	**1 0**	
3.	Pipetted 250 µl of transformation solution (TS, 0.05 M $CaCl_2$) into each tube, then placed tubes in ice. ***Judge verified competitor (i) selected 100-1,000 µl micropipet, (ii) set it to deliver 250 µl, (iii) used a proper pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
4.	Used a sterile plastic inoculation loop to scrape 2–4 *E. coli* colonies from the surface of the starter plate.	**2 0**	
5.	Transferred the loop into the +pGLO tube and swirled it in the transformation solution to disperse bacteria. Closed the tube and placed it back on ice.	**2 0**	
6.	Disposed of loop into biohazard waste receptacle or onto a paper towel for disposal later.	**2 0**	
7.	Used a second sterile plastic inoculation loop to scrape 2–4 *E. coli* colonies from the surface of the starter plate.	**2 0**	
8.	Transferred the loop into the -pGLO tube and swirled it in the transformation solution to disperse bacteria. Closed the tube and placed it back on ice.	**2 0**	
9.	Disposed of loop into biohazard waste receptacle or onto a paper towel for disposal later.	**2 0**	
10.	Pipetted 10 µl of pGLO plasmid (pGLO) into the +pGLO tube and mixed by pipetting gently up and down. Closed the +pGLO tube and placed it back on ice. ***Judge verified competitor (i) used 20 µl micropipet and set it to deliver 10 µl using a correct tip and (ii) did NOT add plasmid to the -pGLO tube.***	**4 0**	
11.	Disposed of pipet tip into biohazard waste receptacle or onto a paper towel for disposal later.	**2 0**	
12.	Verbalized "both tubes will remain on ice for 10 minutes."	**1 0**	
13.	Labeled agar plates with "+pGLO" or "-pGLO" as follows: LB/amp +pGLO, LB/amp/ara +pGLO, LB/amp -pGLO, LB -pGLO ***Judge verified competitor labeled the bottoms of the plates and not the lids.***	**4 0**	
14.	Verbalized "*10 min incubation on ice completed*".	**2 0**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Performing Heat Shock				
15.	Transferred the +pGLO and -pGLO tubes from the ice into a 42^0 C water bath or heat block for exactly 50 seconds, making sure the portion of the tubes containing liquid were in full contact with the water. If using a water bath, use the floating rack provided. Immediately placed tubes back on ice.	**4**	**0**	
16.	Verbalized "*tubes remained on ice for 2 minutes*".	**2**	**0**	
17.	Removed the tubes from ice and pipetted 250 µl of LB broth into each tube. ***Judge verified competitor (i) used 100-1,000 µl micropipet to deliver 250 µl and (ii) changed the pipet tip between each sample, (iii) used a proper pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4**	**0**	
18.	Disposed of pipet tips into biohazard waste receptacle or onto a paper towel for disposal later.	**2**	**0**	
19.	Verbalized "*samples incubated at room temperature for 10 min*".	**1**	**0**	
Plating the Bacteria				
20.	Mixed the tubes by inverting or flicking.	**1**	**0**	
21.	Pipetted 100 µl of the transformation mixtures onto appropriately labeled agar plates (for example, a "+pGLO" mixture onto a "+pGLO plate", etc.). ***Judge verified competitor (i) used 20-200 µl micropipet to deliver 100 µl to each plate, (ii) applied correct sample to correct plate, (iii) changed the pipet tip between each sample, (iv) used a proper pipet tip, (v) transferred liquid without air bubbles or losing sample in the transfer process, and (vi) applied correct sample to correct plates.***	**4**	**0**	
22.	Disposed of pipet tips into biohazard waste receptacle or onto a paper towel for disposal later.	**2**	**0**	
23.	Used a sterile plastic inoculation loop to spread the bacteria over the entire surface of the plate in all directions. Disposed of loop into biohazard waste receptacle or onto a paper towel for disposal later.	**4**	**0**	
24.	Repeated step 23 for each plate. ***Judge verified competitor used a new loop for each plate and the samples matched plates.***	**10**	**0**	
25.	Stacked plates together with lids facing downward, agar side facing up. ***Judge verified competitor placed plates with agar side up.***	**4**	**0**	
26.	Verbalized "*plates would incubate at 37^0C for 16–24 hours*".	**2**	**0**	
Cleaning Up				
27.	Cleaned work area: a. Disposed of used pipet tips, the +pGLO and -pGLO tubes , and used loops into biohazard waste receptacle, cleaned area of any spilled liquid.	**2**	**0**	
	b. Cleaned work area with surface disinfectant.	**2**	**0**	
	c. Properly removed PPE.	**2**	**0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene. ***Judge verified steps 27a-d were performed in the order written here.***	**2**	**0**	
	Total Points- Skill VI: 70% Mastery for Skill VI: 56	**80**		

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill VII: Calculation of Transformation Efficiency

Time: 10 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

	Skill VII: Calculation of Transformation Efficiency	**Possible**	**Awarded**
1	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Counted the number of transformed colonies on the plate and recorded number on the printed scenario or paper provided. If there are >~50 colonies, an estimation made by counting colonies in a quadrant on the plate is acceptable.	**4 0**	
3.	Calculated how many micrograms of DNA were spread onto the plate.	**4 0**	
4.	Expressed answer to #3 using correct units (µg).	**2 0**	
5.	Calculated the transformation efficiency.	**4 0**	
6.	Expressed answer to #5 using correct units (CFU/µg or colonies/µg).	**2 0**	
7.	Removed PPE before leaving the area.	**2 0**	
	Total Points- Skill VII: 70% Mastery for Skill VII: 14	**20**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Biotechnology

Skill VIII: Qualitative ELISA

Time: 20 minutes

Competitor #:_____ **Division:** _____SS, _____PS **Judge's Signature:**_____

	Skill VIII: Qualitative ELISA	**Possible**	**Awarded**
1	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Labeled a 12-well microplate strip: ● the first three wells with **+** for the positive controls ● the next three wells with a **–** for the negative control ● the next three wells with an **S** to indicate the sample.	**2 0**	
Antigen Incubation			
3.	Transferred 50 µl of purified antigen (AG) into each well. ***Judge verified competitor added AG to all 9 wells and (i) used a 20-200 µl micropipet, (ii) set it to 50 µl, (iii) used a proper pipet tip, and (iv) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
4.	Incubated the samples at room temperature for 2 min.	**2 0**	
5.	Followed wash protocol: a. Tipped each microplate strip upside-down onto a short stack of paper towels and gently tapped strip a few times to drain the wells while making sure to avoid splashing sample back into wells.	**2 0**	
	b. Discarded the wet paper towels.	**2 0**	
	c. Used a transfer pipet (same transfer pipet can be used) to fill each well with wash buffer, taking care not to touch the well or spill the buffer into neighboring wells.	**2 0**	
6.	Repeated step #5.	**2 0**	
Sample Incubation (primary antibody)			
7.	Transferred 50 µl of the positive control (+) into the three + wells. ***Judge verified competitor added + to only the first 3 wells labeled + and (i) used a 20-200 µl micropipet set to 50 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
8.	Transferred 50 µl of the negative control (-) into the three – wells. ***Judge verified competitor added - to only the 3 wells labeled - and (i) used a 20-200 µl micropipet set to 50 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

	Skill VIII: Continued...	Possible	Awarded
9.	Transferred 50 µl of the sample (S) into the corresponding three wells. ***Judge verified competitor added S to only the 3 wells labeled S and (i) used a 20-200 µl micropipet set to 50 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
10.	Incubated the samples at room temperature for 2 minutes.	**1 0**	
11.	Performed wash protocol (step 5) two times.	**2 0**	
Enzyme-linked antibody (secondary antibody) incubation			
12.	Transferred 50 µl of enzyme-linked antibody (ELA) into each well. ***Judge verified competitor added ELA to all 9 wells and (i) used a 20-200 µl micropipet set to 50 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
13.	Incubated the samples at room temperature for 2 minutes.	**1 0**	
14.	Performed wash protocol (step 5) three times.	**2 0**	
Substrate Incubation and color development			
15.	Transferred 50 µl of enzyme substrate (SUB) into each well. ***Judge verified competitor added SUB to all 9 wells and (i) used a 20-200 µl micropipet set to 50 µl, (ii) used a proper pipet tip, and (iii) transferred liquid without air bubbles or losing sample in the transfer process.***	**4 0**	
Cleaning Up			
16.	Cleaned work area: a. Disposed of used pipet tips, transfer pipets, and paper towels into waste receptacle, cleaned area of any spilled liquid, returned micropipette to rack (if available).	**2 0**	
	b. Cleaned work area with surface disinfectant.	**2 0**	
	c. Removed PPE.	**2 0**	
	d. Washed hands or used alcohol-based hand-rub for hand hygiene. ***Judge verified steps 16a-d were performed in the order written here.***	**2 0**	
17.	Observed and reported results. ***Judge verified (+) and S wells were blue, (-) was colorless; competitor confirmed sample was positive.***	**4 0**	
	Total Points- Skill VIII: 70% Mastery for Skill VIII: 39.2	**56**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.